AIR ROUTES TO AUSTRALIA.

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Lord Montague, the authority on aeronautics, in a recent lecture, has said:

> It is clear that meteorology and the study of wind currents is going to be of supreme importance. The knowledge of the world's atmospheric conditions and accurate forecasts, apart from their inherent scientific interest, may effect the saving or spending of millions of money annually when postal and commercial aviation is established.

The advent of steam has decreased the economic importance of surface winds and currents, but the sailing

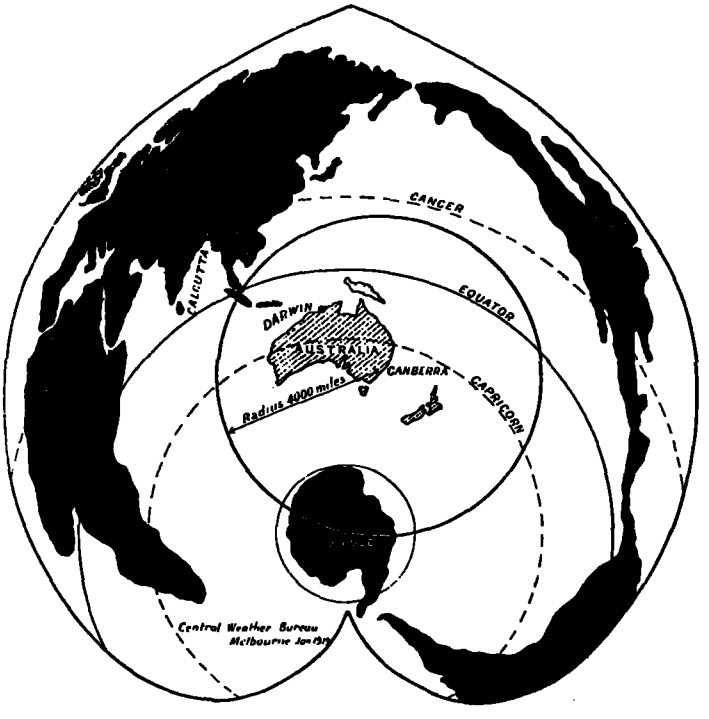

FIG. 1.—The isolation of Australia.

ships in the Australian trade are still bound by weather laws, and have only one route. They come from Africa to Australia, and return to Europe via Cape Horn. The reverse route—though possible—involves permanent head winds and unfavorable currents which take it out of the realms of economic trade. Much more will the air routes depend on the variations of weather and climate.

The study of surface winds and of the general circulation of the atmosphere dates back to very early times, but it was first put on a firm basis in 1856 by Ferrel's and Maury's treatises. The first experimental investigations of upper currents, apart from the study of clouds, volcanic banners, etc., were made about 1890, and a little later the Hargraves box kite (invented in Australia) was used profitably in America for this purpose.

It is, however, only in the last 20 years that the exploration of the upper air has been carried out at all generally, but now research is worldwide. For instance, in 1911 Simpson first sent up sounding balloons in Antarctica (where the writer was initiated), and in 1913 and 1914 the upper air of Australia was investigated in the same way at Melbourne. The conditions over our northern regions are almost unknown, and we depend on Java for any knowledge that is available.

Like so many scientific experiments their immediate practical value was not obvious to the man in the street. Now, however, that aviation has come to its own, these explorations of the upper air have already proved of value. The American Government has devoted $100,000 to meteorological research connected with military aviation; and it is to be hoped that our military and political authorities will show more interest in the future than they have hitherto done in the matter.

Let us now see which are the most promising routes to our isolated continent. The writer has given the matter considerable attention in his lectures at the aviation school. In figure 1 is given a somewhat unusual world map (on Sylvanus' projection), where the position of Australia with regard to the other continents is well brought out. Though the edges of the map are necessarily distorted, it shows us that Australia is situated in the center of the largest expanse of water in the world, which we may term the Pacifico-Indian Ocean. This sheet of water is itself surrounded on all sides by land, except to the south of Africa—for Antarctica entirely shuts off the waters to the south of Australia—and this ocean will for long prove an obstacle to flights from most of the continents.

If we draw a circle of 4,000 miles radius from Canberra (which is happily placed almost at the center of population of Australia), we find that it passes right through Antarctica (near the South Pole), but includes none of

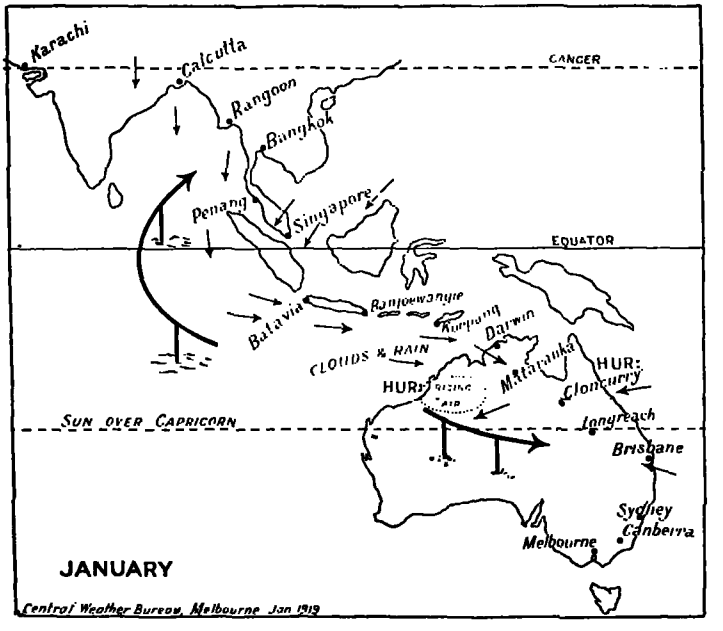

FIG. 2.—Dominant winds in January. Upper-air currents on stilts.

the other large masses. Our nearest continent is therefore of little use as a flying depot. Africa and the Americas are ruled out by distance; they are separated from us by 7,000 miles of water, with but few islands in most directions. There remains, therefore, Asia—and it is by way of India and the Straits Settlements that we may expect our earlier aeroplane services to travel.

Nature has placed stepping stones from India to Australia in the form of the drowned volcanic ranges, which are, of course, the islands of Sumatra, Java, and Timor; and these lead directly to Darwin, the chief settlement on the north coast.

We have all read of the recent flights from England to India; they were accomplished with comparative ease in about four days and will soon become almost weekly occurrences. I have drawn up a list of stations from Calcutta to Canberra with their distances. At all of these, except perhaps Koepang and Mataranka, there are, I believe, stores of petrol and facilities for repair. (See fig. 2.)

As regards the time occupied, Lord Montague in his paper on the World's Air Routes assumes about 1,200 miles per day as the average passenger-plane speed. Mr. Holt-Thomas in a recent lecture before the Aeronautical Society showed a map of the world crossed by air routes, where Sydney is only five days from England. This is twice as rapid as the recent flight and is probably much more rapid than the earlier services are likely to accomplish regularly. I have assumed 1,500 miles in 24 hours, which makes it about four days from Calcutta to Canberra, allowing for favoring winds.

FIRST DAY.	Miles.
Calcutta—	
Rangoon (Burmah)	650
Bangkok (Siam)	350
Penang (Malay States)	580
	1,580

SECOND DAY.	Miles.
Penang (Malay States)—	
Singapore (Malay States)	350
Batavia (northwest Java)	560
Banjowanjie (southeast Java)	520
	1,430

THIRD DAY.	Miles.
Banjowanjie—	
Koepang (Timor) (here follows the only oversea journey)	680
Darwin	500
Mataranka (suggested inland capital, N. T.)	250
	1,430

FOURTH DAY.	Miles.
Mataranka—	
Cloncurry	600
Longreach	300
Brisbane	600
	1,500

FIFTH DAY.	Miles.
Brisbane to Sydney	500
Brisbane to Canberra	600
Brisbane to Melbourne	900

Let us look more particularly into the meteorological factors on this route. It lies almost entirely in the monsoon and trade-wind regions, whose climates differ materially from those to which most of us are accustomed.

The trade wind is a surface wind blowing from the southeast (over Australia) to the Equator. (See fig. 3.) Its limits vary during the year, for the belt is farther north in winter than in summer, moving with the sun. In our winter (July) these winds reach the Equator, i. e., almost to Singapore, and will obviously hinder the aeroplane coming from India, but will help the return flight. In our summer (fig. 2) their influence is not felt much north of the Tropic of Capricorn, and only the last day's journey from India will be affected. In the Northern Hemisphere the trade winds blowing from the northeast will be cross winds in January and will be obliterated in July by the periodical monsoons.

Very little research on the limits of the trade winds either in height or in latitude has been done in the Southern Hemisphere, but the following notes embody what is available.

The trade wind in North Queensland blows on an average about 20 miles per hour for weeks at a time, but it is probably less in other portions of its belt. This steady drift can obviously affect very considerably the velocity of the plane. This layer of the trade winds is, however, of limited thickness, for above it blows a poleward return wind. This is reached about 12,000 feet above sea level near the Tropics (according to German data), but is lower in temperate regions. It is often reached in ascending 4,000 feet above Melbourne, and high regions like Kosciusko experience the west wind very frequently. We know nothing directly of its depth in our Tropics.

These heights mentioned are quite those of the regular flight zones. Hence our air captain will doubtless fly from the Equator to southern Australia at high levels

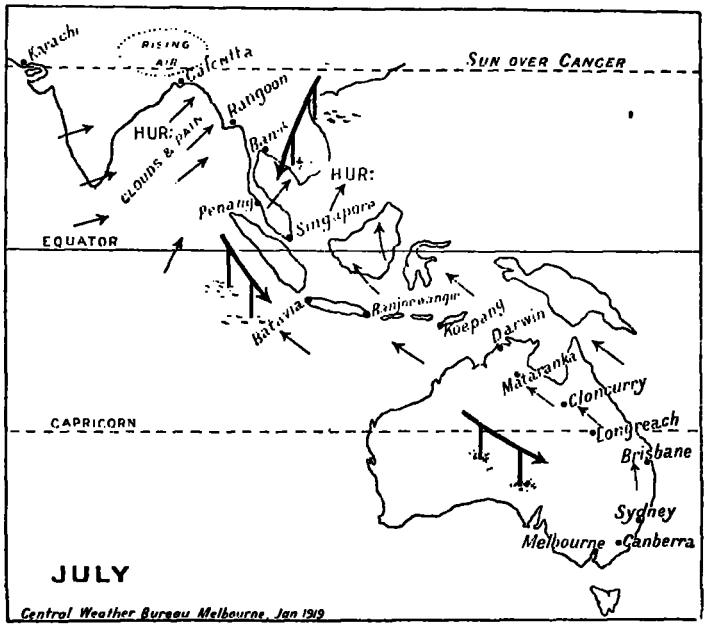

FIG. 3.—Dominant winds in July. Winds of the upper-flying layers on stilts.

when the surface winds in July are against him in this permanent antitrade wind. At these elevations wind forces are much stronger, for there is little friction due to obstructions or turbulent eddies at heights above a mile. For instance, at the upper flight limit the winds in temperate latitudes have an average of about 60 miles per hour.

During the summer seasons in the region discussed there is the maximum development of monsoons. The strong southwest monsoon of India blows during the hot months and is accompanied by dense clouds, thunderstorms, and much rain. These winds are not favorable either in direction or in their accompanying meteorology for aviation. But here again they are confined to the lower 12,000 feet, and above this (as the Dutch have shown in Java) are found trade winds. The winter monsoon is practically the same as the trade wind.

In Australia the northwest monsoon blows in our northern regions during the three hottest months. It is a turbulent wind layer, and probably the aviator will prefer to fly above it, though the dominant monsoon wind from the northwest would help him to the south.

Its extent and character can only be surmised at present.

Where the sun is vertically overhead the air is rising, and though these are calm regions at the surface they are certainly turbulent areas in the flight zone. However, though heat bumps on a large scale may be apparent, they have not much significance for a modern plane and can be avoided by high flying.

The most violent storms of the Tropics are the occasional hurricanes. Luckily these are confined to the oceans and rarely cause much damage far inland. They are prevalent in summer in the regions indicated, but aeroplanes flying overland will not often be dangerously affected. This is an unknown field of research, but one which it is disastrous to postpone much longer.

The southern portion of Australia is dominated by anticyclones at the surface, and by the westerly drift above. Here we are on more familiar ground. The anticyclones are surrounded by variable winds, generally unimportant from the present point of view. They have clear skies and afford good flying weather. The aviator will be interested in the more intense LOWS (or cyclones) which periodically travel across southern Australia, but they are regularly forecast and should not catch him unprepared for their clouds, rain, and strong winds.

I began this article with a quotation and will conclude with one. Lieut. Col. O'Gorman, in the last Wilbur Wright Memorial lecture, stated:

> Commercial aeronautics is bound up with using the [special] values which accrue incidentally to the employment of aircraft. I take three of these: (A) Speed of transit. (B) Directness of route. (C) The utilization of helpful winds and evading bad weather.

Much more might be written on this topic, but it is hoped that the reader will now realize how intimate is the connection between meteorology and aviation, and also how much remains to be done in a scientific preparation for the forthcoming aerial traffic.

REPORT OF THE BRITISH CIVIL AERIAL TRANSPORT COMMITTEE.[1]

[Review by W. R. GREGG.]

Under this heading has recently appeared the most complete and comprehensive discussion of the civil and commercial possibilities of aviation that has yet been published in any country. The committee, which is a large one, was appointed May 22, 1917, other members being added on subsequent dates. The list includes such well-known meteorologists as Sir Napier Shaw, Col. H. G. Lyons, and Maj. G. I. Taylor. The purpose of the committee was to consider and report with regard to:

1. The steps which should be taken with a view to the development and regulation after the war of aviation for civil and commercial purposes from a domestic, and imperial, and an international standpoint.
2. The extent to which it will be possible to utilize for the above purpose the trained personnel and the aircraft which the conclusion of peace may leave surplus to the requirements of the Naval and Military Air Services of the United Kingdom and Overseas Dominions.

In order to make the investigation as thorough and authoritative as possible, five special committees were formed, and they considered and rendered reports covering the following subjects:

1. Questions of law and policy.
2. Technical and practical questions as to the possibilities of performance of aircraft and as to the requirements of aerial services.
3. Business questions relating to the position of the aircraft manufacturing industry after the war, the probabilities of the establishment of aerial transport services and the steps which would be necessary for the maintenance of this industry and for the development of these services.
4. Questions of labor arising in the aircraft manufacturing industry and in aerial transport services.
5. Problems of scientific research and the special education of expert designers, engineers, and pilots.

The report of Special Committee No. 5, and the comments thereon by the Main Committee, are of special interest to meteorologists. Memoranda from Sir Napier Shaw, Col. Lyons, and Maj. Taylor set forth in some detail the character of the investigations that are being regularly conducted by the Meteorological Office and point out the need of development and enlargement along certain lines, in order to furnish aviators with reliable information as to conditions along any selected course. After considering the recommendations contained in these memoranda, the Special Committee calls attention to the following points:

The necessity for a closer study of atmospheric conditions at great heights.

The investigation of the phenomena of mist and fog and abnormal air currents in special localities.

The necessity for an organized scheme for improving the supply of information from the meteorologist to the flier and vice versa.

The desirability of preparing meteorological information in a form most suitable for aviators from the existing material, not only for the United Kingdom, but for so much of Europe and for such air routes as may be selected.

The necessity for increased facilities for aeronautical research at the Meteorological Office.

The necessity for local meteorological establishments at appropriate terminal aerodromes, connected by telephone with the Meteorological Office and with each other.

The necessity for instituting meteorological research centers in connection with universities and other centers of education.

The necessity for the issue of suitable handbooks for the purpose of instructing fliers in meteorology.

Truly, the carrying out of these projects is an ambitious program, but it is one that can and should be undertaken and developed, not only in England, but in the United States and other countries as well.

Particularly timely are the portions of the report dealing with trans-Atlantic flight. No definite conclusion is reached as to which route is preferable, but, so far as the Newfoundland fogs are concerned, it is pointed out by Maj. Taylor that these are low in altitude and do not extend far inland. Statements confirming this conclusion are quoted from correspondence with Sir E. Morris and Mr. H. C. Thomson, whose experience of several years in Newfoundland leads them to assert that no difficulty should be encountered in locating a landing field a short distance from the coast that would be practically free from fog.

Other parts of the Reports of Special Committees and of the Main Committee, though of less interest to the meteorologist, contain much valuable information and suggestion to the aviator and will well repay careful reading and study.

[1] Published by his majesty's stationery office, London, 1918. Certain portions of a confidential or secret nature were not included.